In the Specification

Please amend the paragraph beginning on page 4, line 26 as follows:

FIG. 4 is a ~~top~~ perspective view of one embodiment of an antenna array and feed network according to the invention;

Please amend the paragraph beginning on page 5, line 13 as follows :

FIG. 12 is a front schematic view of one embodiment of an antenna array, according to the invention;

Please amend the paragraph beginning on page 5, line 15 as follows:

FIG. 13 is a side schematic view of another embodiment of an antenna array shown within a circle of rotation, according to the invention;

Please amend the paragraph beginning on page 5, line 18 as follows:

FIG. 15 is a back schematic view of one embodiment of an antenna array illustrating an example of a waveguide feed network according to the invention;

Please amend the paragraph beginning on page 7, line 19 as follows:

The mountable subsystem 50 may include a mounting bracket 58 to facilitate mounting of the mountable unit 50 to the vehicle 52. According to one embodiment, the mountable unit may be moveable in one or both of elevation and azimuth to facilitate communication with the information source 56 from a plurality of locations and orientations. In this embodiment, the mounting bracket 58 may include, for example, a rotary joint and a slip ring 57, shown on FIG. 3, as discrete parts or as an integrated assembly, to allow radio frequency (RF), power and control signals to travel, via cables, between the movable mountable subsystem 50 and a stationary host platform of the vehicle 52. The rotary joint and slip ring combination 57, or other device known to those of skill in the art, may enable the mountable subsystem 50 to rotate continuously in azimuth in either direction 60 or 62 (see FIG. 1A) with respect to the host vehicle 52, thereby enabling the mountable subsystem to provide continuous hemispherical, or greater, coverage when used in combination with an azimuth motor. Without the rotary joint, or

similar device, the mountable subsystem 50 would have to travel until it reached a stop then travel back again to keep cables from wrapping around each other.

Please amend the paragraph beginning on page 9, line 3 as follows:

Again referring to FIG. 2, in one embodiment, the mountable subsystem 50 may comprise an antenna assembly 100 that may include an antenna array 102 and a polarization converter unit (PCU) 200. In a receive mode of the communication system, the antenna array 102 may be adapted to receive incident radiation from the information source (56, FIGS. 1A & 1B), and may convert the received incident electromagnetic radiation into two orthogonal electromagnetic wave components. From these two orthogonal electromagnetic wave components, the PCU may reproduce transmitted information from the source whether the polarization of the signals is vertical, horizontal, right hand circular (RHC), left hand circular (LHC), or slant polarization from 0° to 360°, and provide RF signals on lines ~~106~~ 208, 210. A part of, or the complete, PCU 200 may be part of, or may include, or may be attached to a feed network of the antenna array. The PCU 200 may receive the signals on lines 106, and provide a set of either linearly (vertical and horizontal) polarized or circularly (right-hand and left-hand) polarized signals on lines 106. Thus, the antenna array 102 and the PCU 200 provide an RF interface for the subsystem, and may provide at least some of the gain and phase-matching for the system. In one embodiment, the PCU may eliminate the need for phase-matching for the other RF electronics of the system. The antenna assembly 100, including the antenna array 102 and the PCU 200, will be discussed in more detail *infra*.

Please amend the paragraph beginning on page 12, line 7 as follows:

As described above, because of height and/or space constraints on the antenna array, it may in some applications be desirable to use a low-height, wide aperture horn antenna 110. However, such a horn antenna may have a lower gain than is desirable because, as shown in FIG. 5, there may be a significant path length difference between a first signal 128 vertically incident on the horn aperture 116, and a second signal 130 incident along the edge 118 of the antenna. This path length difference may result in significant phase difference between the first and second signals 128, 130. Therefore, according to one embodiment, it may be desirable to couple

a dielectric lens 114 to the horn antenna 110, as shown in FIG. 4, to match the phase and path length, thereby increasing the gain of the antenna array 102.

Please amend the paragraph beginning on page 15, line 3 as follows:

The size of the lens and of the grooves formed in the lens surface may be dependent on the desired operating frequency of the dielectric lens 114. In one specific example, a dielectric lens 114 designed for use in the Ku frequency band (10.70 - 12.75 GHz) may have a height 136 of approximately 2.575 inches, and diameter 138 of approximately 7.020 inches. In this example, the grooves 132 may have a width ~~138~~ <u>139</u> of approximately 0.094 inches and the concavity 134 formed at the base of each of these grooves may have a radius of approximately 0.047 inches. As illustrated in FIG. 6D, in this example, the lens 114 may possess a total of nineteen concentric grooves. In one example, the grooves may penetrate the surface by approximately one quarter-wavelength in depth near the center axis and may be regularly spaced to maintain the coherent summing of the direct and internally reflected signals, becoming successively deeper as the grooves approach the periphery of the lens. According to one specific example, the center-most concentric groove may have, for example, a depth of 0.200 inches, and the outermost groove may have, for example, a depth of 0.248 inches. The grooves may be evenly spaced apart at gaps of approximately 0.168 inches from the center of the lens. Of course, it is to be appreciated that the specific dimensions discussed above are one example given for the purposes of illustration and explanation and that the invention is not limited with respect to size and number or placement of grooves. Although the illustrated example includes nineteen grooves, the dielectric lens 114 may be formed with more or fewer than 19 grooves and the depths of the grooves may also be proportional to the diameter of the lens, and may be based on the operating frequency of the dielectric lens.

Please amend the paragraph beginning on page 16, line 4 as follows:

According to another embodiment, a convex-plano lens according to aspects of the invention may comprise impedance matching grooves 132, 140 formed on both the convex lens surface and the planar surface, as shown in FIG. 6D. Referring to FIG. 6C, according to one example, a planar side 142 may be formed opposite the convex side of the lens. A ~~width~~ <u>diameter</u> of the planar side 142 may be reduced relative to the overall diameter of the lens by, for example, milling. The reduced ~~width~~ <u>diameter</u> of planar side 142 allows for the lens to be partially inserted into the horn antenna. According to one specific example, the dielectric lens 114 may have a radius of approximately 3.500 inches. Outside a radius of approximately 3.100

inches on the non-convex side of the lens structure from its center, the planar side 142 is formed to reduce the overall ~~width~~ height of the lens by approximately 0.100 of an inch, as shown in FIG. 6C. Accordingly, a portion of the outermost edge of the planar side of the lens measuring approximately 0.400 inches in length and 0.100 inches in ~~width~~ height is removed. From the center-most point of the planar side to a radius of, for example, 3.100 inches, concentric grooves 140 may be milled into the planar surface 142 of the lens, similar to the grooves 132 which are milled on the convex, or opposite, side of the lens structure.

Please amend the paragraph beginning on page 19, line 22 as follows:

Referring to FIG. 11, there is illustrated another embodiment of a dielectric lens 161 according to the invention. In this embodiment, the dielectric lens 161 uses a plano-convex shape for a perimeter lens surface 163 and a bi-convex lens shape for an interior lens surface 165. Each of the perimeter surface 163 and the interior surface 165 may have one or more grooves 167 formed therein, as discussed above. In addition, the dielectric lens 161 may have a Fresnel-like feature ~~167~~ 169 formed therein, as discussed above to reduce the weight of the lens 161. An optimum refractive plano- or bi-convex structure may be achieved by using a deterministic surface for one side of the lens 161 (e.g., a planar, spherical, parabolic or hyperbolic surface) and solving for the locus of points for the opposite surface. In the illustrated embodiment, the bi-convex portion 165 is designed with a spherical surface on one side of the lens and an optimized locus on the other side.

Please amend the paragraph beginning on page 22, line 18 as follows:

According to one example, the dielectric lens 114 may be designed to fit over, and at least partially inside, the horn antenna 110, as shown in FIG. 13. The lens 114 may be designed such that, when mounted to the horn antenna 110, the combination of the horn antenna 100 and the lens 114 may still fit within a constrained volume, such as a circle of rotation 188. In one example, a diameter of the lens 114 may be approximately equal to a diameter of the horn antenna 110, and a height of the lens 114 may be approximately half of the diameter of the horn antenna 110. According to another example, the lens 114 may be self-centering with respect to the horn antenna ~~100~~ 110. For example, the shape of lens 114 may perform the self-centering function, such as the lens 114 may have slanted edge portions 115 (see FIG. 7) which serve to

center the lens 114 with respect to the horn antenna 110. In one example, the slanted edge portions 115 of the lens may match a slant angle of the horn antenna 110. For example, if the sides of the horn antenna 110 are at a 45° angle with respect to vertical, then the slanted edge portions 115 of the lens may also be at a 45° angle with respect to vertical.

Please amend the paragraph beginning on page 23, line 1 as follows:

Referring again to FIG. 13, the waveguide feed network 112 may also be designed to fit within the circle of rotation 188. In another example, illustrated in FIG. 3, the mountable subsystem 50 which may also include the gimbal assembly ~~60~~ 300 to which the horn antennas 110 and lenses 114 may be attached, and a covering radome (not shown) may be designed to fit within a constrained volume (e.g., the circle of rotation FIG 13, 188) discussed above. In one example, the feed network 112 may be designed to fit adjacent to the curvature of the horn antenna 110, as shown, to minimize the space required for the feed network.

Please amend the paragraph beginning on page 23, line 8 as follows:

According to another example, the lens 114 may be designed such that a center of mass of the lens 114 acts as a counterbalance to a center of mass of the corresponding horn antenna 110 to which the lens is mounted, moving a composite center of mass of the lens and horn closer to a center of rotation of the entire structure, in order to facilitate rotation of the structure by the gimbal assembly ~~60~~ 300.

Please amend the paragraph beginning on page 23, line 13 as follows:

Referring to FIGS. 3 and 13, according to yet another embodiment, certain of the horn antennas 110, for example those located at ends of the antenna array 102, may include a ring 190 formed on a surface of the horn antenna ~~100~~ 110 to facilitate mounting of the horn antenna 110 to the gimbal assembly ~~60~~ 300. As shown in FIG. 14, the ring 190 may be adapted to mate with a post 192 that is coupled to an arm 194 that extends from the gimbal assembly 300 (see FIG. 3) to mount the antenna array 102 to the gimbal assembly 300 and to enable the gimbal assembly to move the antenna array 102. The ring 190 may be formed on an outer surface of the horn antenna ~~100~~ 110, near the aperture of the horn antenna, i.e. near a center of rotation of the

antenna array, as shown in FIG. 13. In one example, the ring 190 may be integrally formed with the horn antenna 110.

Please amend the paragraph beginning on page 24, line 15 as follows:

In the illustrated example in FIG. 16, the ports 608, 610 of the OMT 604 are located on sides 612, 614 of the OMT ~~605~~ 604, at right angles to the input port 606. This arrangement may reduce the height of the OMT 604 compared to conventional OMT's which may typically have one output port located on an underside of the OMT, in-line with the input port. The reduced height of the OMT 604 may help to reduce the overall height of the antenna array 102 which may be desirable in some applications. According to the example shown in FIG. 16, OMT 604 includes a rounded top portion 616 so that the OMT 604 may fit adjacent to sides of the horn antenna element, further facilitating reducing the height of the antenna array. In one example, the OMT 604 may be integrally formed with the horn antenna 110. It is further to be appreciated that although the OMT 604 has been described in terms of the antenna receiving radiation, i.e. the OMT 604 receives an input from the antenna at port 606 and provides two orthogonal output signals at ports 608, 610, the OMT 604 may also operate in the reverse. Thus, the OMT 604 may receive two orthogonal input signals at ports 608, 610 and provide a combined output signal at port 606 which may be coupled to the antenna that may radiate the signal.

Please amend the paragraph beginning on page 25, line 1 as follows:

Referring again to FIG. 15, the feed network 112 includes a plurality of path elements connected to each of the ports 608, 610 of the OMT's 604. The feed network 112 may include a first path 618 (shown hatched) coupled to the ports 608 of the OMT's 604 along which the first component signals (from each antenna) may travel to the first feed port 600. The feed network ~~12~~ 112 may also include a second path 620 coupled to the ports 610 of the OMT's 604 along which the second component signals (from each antenna) may travel to the second feed port 602. Thus, each of the orthogonally polarized component signals may travel a separate path from the connection points OMT ports 608, 610 to the corresponding feed ports 600, 602 of the feed network 112. According to one embodiment, the first and second paths 618, 620 may be symmetrical, including a same number of bends and T-junctions, such that the feed network 112 does not impart any phase imbalance to the first and second component signals.

Please amend the paragraph beginning on page 27, line 20 as follows:

Referring to FIG. 20 there is illustrated a functional block diagram of one embodiment of a gimbal assembly 300. As discussed above, the gimbal assembly 300 may form part of the mountable subsystem 50 that may be mounted on a passenger vehicle, such as, for example, an aircraft. It is to be appreciated that while the following discussion will refer primarily to a system where the mountable subsystem 50 is externally located on an aircraft 52, as shown in FIG. 1B, the invention is not so limited and the gimbal assembly 300 may be located internally or externally on any type of passenger vehicle. The gimbal assembly 300 may provide an interface between the antenna assembly 100 (see FIG. 2) and a receiver front-end. According to the illustrated example, the gimbal assembly 300 may include a power supply 302 that may supply the gimbal assembly itself and may provide power on line 304 to other components, such as, the PCU and DCU. The gimbal assembly 300 may also include a central processing unit (CPU) 306. The CPU 306 may receive input signals on lines 308, 310, 312 that may include data regarding the system and/or the information signal source, such as system coordinates, system attitude, source longitude, source polarization skew and source signal strength. In one example, the data regarding the source may be received over an RS-422 interface, however, the system is not so limited and any suitable communication link may be used. The gimbal assembly 300 may provide control signals to the PCU ~~400~~ 200 (see FIG. 2) to cause the PCU 200 to correct for polarization skew between the information source and the antenna assembly, as will be discussed in more detail below.

Please amend the paragraph beginning on page 31, line 14 as follows:

Referring again to FIG. 21, the PCU may receive the first and second orthogonal component signals, from the feed ports 600, 602 of the feed network, on lines 208, 210, respectively. In one example, the first and second component signals may be in a frequency range of approximately 10.7 GHz – 12.75 GHz. The first and second component signals may be amplified by low noise amplifiers 224 that may be coupled to the ports 600, 602 of the feed network by a waveguide feed connection. The low noise amplifiers are coupled to directional couplers 226 via, for example, semi-rigid cables. The coupled port of the directional couplers 226 is connected ~~via a splitter 228~~ to a local oscillator 222. The local oscillator 222 may be

controlled, through the control interface 202, by the gimbal assembly (which communicates with the control interface 202 over line(s) 322) to provide a built-in-test feature. In one example, the local oscillator 222 may have a center operating frequency of approximately 11.95 GHz.

Please replace equation (5) on page 32 with the following equation:

$$A = 10 * \log((\tan(\beta))^2$$

Please amend the paragraph beginning on page 34, line 4 as follows:

DCU ~~300~~ 400 may provide an RF interface between the PCU 200 and a second down-converter unit 500 (see FIG. 2) that may be located within the vehicle. In many applications it may be advantageous to perform the down-conversion operation in two steps, having the first down-converter co-located with the antenna assembly 100 so that the RF signals only travel a short distance from the antenna assembly to the first DCU 400, because most transmission media (e.g. cables) are significantly less lossy at lower, IF frequencies than at RF frequencies. Down conversion to a lower frequency reduces the need for specifying low loss high frequency cable which is typically very bulky and difficult to handle.

Please amend the paragraph beginning on page 34, line 12 as follows:

According to one embodiment, the DCU 400 may receive power from the gimbal assembly 300 via line 413. The DCU 400 may also be controlled by the gimbal assembly 300 via the control interface 410. According to one embodiment, DCU 400 may receive two RF signals on lines 106 from the PCU 200 and may provide output IF signals on lines 76. Directional couplers 402 may be used to inject a built-in-test signal from local oscillator 404. A switch 406 that may be controlled, via a control interface 410, by the gimbal assembly (which provides control signals on line(s) 322 to the control interface 410) is used to control when the built-in-test signal is injected. A power divider 428 may be used to split a single signal from the local oscillator ~~406~~ 404 and provide it to both paths.

Please amend the paragraph beginning on page 34, line 30 as follows:

As discussed above, the gimbal assembly 300 may include a tracking feature wherein the gimbal CPU ~~304~~ 306 uses a signal received from the DCU 400 on line 322 to provide control signals to the antenna array to facilitate the antenna array tracking the information source. According to one embodiment, the DCU 400 may include a control interface 410 that communicates with the gimbal CPU ~~304~~ 306 via line 322. The control interface 41 may sample the amplitude of the IF signal on either path using couplers 412 and RF detector 434 to provide amplitude information that may be used by the CPU ~~304~~ 306 of the gimbal to track the satellite based on received signal strength. An analog-to-digital converter 436 may be used to digitize the information before it is sent to the gimbal assembly 300. If the DCU is located close to the gimbal CPU, this data may be received at a high rate, e.g. 100 Hz, and may be uncorrupted. Therefore, performing a first down-conversion, to convert the received RF signals to IF signals, close to the antenna may improve overall system performance.

Please amend the paragraph beginning on page 35, line 10 as follows:

The CPU ~~304~~ 306 of the gimbal may include software that may utilize the amplitude information provided by the DCU to point at, or track, an information source such as a satellite. The control interface may provide signals to the gimbal assembly to allow the gimbal assembly to correctly control the antenna assembly to track a desired signal from the source. In one example, the DCU may include a switch ~~430~~ 414 that may be used to select whether to track the vertical/RHC or horizontal/LHC signals transmitted from an information source, such as a satellite. In general, when these signals are transmitted from the same satellite, it may be desirable to track the stronger signal. If the signals are transmitted from two satellites that are close, but not the same, it may be preferable to track the weaker satellite.

Please amend the paragraph beginning on page 39, line 5 as follows:

According to the illustrated example, the DCU-2 500 may include band-pass filters 510 that may be used to filter out-of-band products from the signals. The received signals are mixed, using mixers 512, with a tone from one of a selection of local oscillators 514. Each local oscillator 514 may be tuned to a particular band of frequencies, as a function of the satellites (or other information signal sources) that the system is designed to receive. Which local oscillator is mixed in mixers 512 at any given time may be controlled, using switches 516, by control signals received from the gimbal assembly by the control interface 502. The output signals may be amplified by amplifiers 518 to improve signal strength. Further band-pass filters 520 may be used to filter out unwanted mixer products. In one example, the DCU-2 500 may include a built-in-test feature using an RF detector 522 and couplers 524 to sample the signals, as described above in relation to the DCU and PCU. A switch 526 (controlled via the control interface ~~506~~ 502) may be used to select which of the four outputs is sampled for the built-in-test.